BC hydro

Short Term
Electric Load Forecast
1990/91 - 1995/96

Prepared by Forecasting Development

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FOREWORD

Starting this year, two electricity load forecasts will be developed for short and long term planning. This document presents B.C. Hydro's 1990 short term forecast of gross electric requirements to 1995/96.

The short term forecast covers the next six years and will be updated at least annually for distribution and budget planning.

The short term forecast will be monitored on a continuous basis and a monthly sales variance report will be published. Major forecasting assumptions will be reviewed on a quarterly basis. If necessary, forecasting updates will be issued to serve as guidelines for adjusting other planning needs.

A long term outlook will be formulated as part of the Integrated Electric Plan. It covers the next 20 years and will be updated bi-annually for transmission and resource planning.

EXECUTIVE SUMMARY

Three load growth scenarios are prepared. All three scenarios assume that economic growth for the next two years will be moderate with worse than expected economic conditions assumed for the low forecast. The main difference is in assumptions used for the last three years of the forecast period. The low forecast assumes that the economy will recover slowly. The base forecast assumes the expected load additions will be realized. The high forecast assumes a higher load growth because of better than expected economic conditions.

BASE FORECAST

1. The population forecast is the main driver for projecting future number of accounts in the residential forecast. The base case forecast uses population projections provided by the B.C. Ministry of Finance and Corporate Relations. Over the next six years, the average annual growth rate is projected to be 2.1%.

   Residential use per account is projected to level off and sales will keep pace with projected population increase.

2. The Gross Domestic Product (GDP) forecast forms the base for projecting future increase in commercial floor stock. The base case forecast uses GDP projections provided by the B.C. Ministry of Finance and Corporate Relations. Over the next six years, the average annual growth rate is projected to be 2.9%.

   Commercial use per unit of floor stock is forecast to continue to increase. Sales will keep pace with commercial GDP between 1990/91 to 1993/94; then rise above the commercial GDP from 1994/95 to 1995/96.

3. Information for the industrial forecast comes mainly from B.C. Hydro's transmission customers. Input provided by outside consultants is used to prepare an outlook for the forestry and paper and allied products industry.

   Industrial sales will continue to be dominated by the demand of the paper and allied products subsector. Growth in sales in all other industrial subsectors is assumed to remain moderate over the entire forecast period. Sales growth in the wood manufacturing subsector will occur largely from technological upgrading and the addition of more value-added products. Major assumptions are:

   - the paper and allied products subsector is forecast to operate at an industry-wide average operating rate of 80% between 1990/91 to 1993/94 and 90% for 1994/95 and 1995/96;
   - the addition of two new thermomechanical pulp (TMP) mills in the last two years of the forecasting period;
   - the addition of a fibreboard plant in 1992;
   - the closure of two metal mines and the addition of two new coal mines between 1991/92 and 1995/96.

ALTERNATIVE SCENARIOS

Alternative scenarios of potential changes which could impact electricity sales are analyzed. Two possible alternatives are considered to reflect the upper and lower bounds of uncertainty.

The lower demand scenario is designed to address concerns about a possible downturn in the economy by emulating economic conditions of B.C.'s last major recession in the early 1980s. The combined impact of a lower population growth, a decrease in GDP and in industrial production would reduce electricity sales by 1,165 GW.h in 1990/91 and 2,548 GW.h in 1991/92. Sales would be reduced by a total of 16,247 GW.h and the annual average growth rate would be lowered from 3.6% to 2.2% over the five-year period.

The high demand scenario assumes B.C. will escape the worst of the economic downturn in the near term and will have a higher than expected growth towards the end of the forecast period. The combined impact of maintaining the same growth as the base forecast for 1990/91 and 1991/92 and higher than expected growth from 1992/93 to 1995/96 will increase sales by 7,125 GW.h and raise the annual average growth rate from 3.6% to 4.5% over the five-year period.

ENERGY FORECAST

	1995/96			Average Annual Growth		
	High	Base	Low	High	Base	Low
Gross Requirements (GW.h)	57,574	54,783	50,435	4.7%	3.9%	2.5%
Peak (MW)	10,065	9,609	8,902	4.9%	4.1%	2.8%
Total Sales (GW.h)	51,075	48,566	44,658	4.5%	3.6%	2.2%
Residential Sales (GW.h)	13,290	12,988	12,393	3.2%	2.8%	2.0%
Commercial Sales (GW.h)	13,148	12,433	11,466	4.5%	3.5%	2.2%
Industrial Sales (GW.h)	23,357	21,865	19,519	4.9%	3.8%	1.9%
Other Sales (GW.h)	1,280	1,280	1,280	10.2%	10.2%	10.2%

POWER SMART PROGRAMS

Power Smart is B.C. Hydro's name for demand side management programs. Estimated load reductions from Power Smart programs are being included as energy sources for resource planning.

TABLE OF CONTENTS

FOREWORD i

EXECUTIVE SUMMARY ii
BASE FORECAST ii
ALTERNATIVE SCENARIOS iii
ENERGY FORECAST iii
POWER SMART PROGRAMS iii

INTRODUCTION 1

BASE ECONOMIC FORECAST 1
Sources of Inputs 1
Base Economic 1
Base Population Forecast 2
Outlook 2

BASE ENERGY FORECAST 3
Total Energy Requirements 3
Total Gross Requirements 3
Peak 3
Total Sales 4

RESIDENTIAL SALES 6

COMMERCIAL SALES 7

INDUSTRIAL SALES 8
Paper and Allied Products 8
Wood Manufacturing 9
Chemical and Chemical Manufacturing 9
Metal Mining 9
Coal Mining 10
Remainder of Industrial 10

OTHER SALES 11

POWER SMART PROGRAMS 11

SENSITIVITY ANALYSIS 11
Residential Sales 11
Commercial Sales 12
Industrial Sales 12
Combined Scenarios 12

APPENDIX A 14
SENSITIVITY ANALYSIS METHODOLOGY 14
Residential Sales 14
Commercial Sales 14
Industrial Sales 15
Combined Scenarios 15

APPENDIX B 18
INPUTS TO THE FORECAST 18
Residential 18
Commercial 18
Industrial 19

APPENDIX C 20
B.C. HYDRO BASE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS 20

APPENDIX D 21
COMPARISON OF B.C. GDP 21
COMPARISON OF B.C. POPULATION 21

APPENDIX E 22
COMPARISON OF 1990 vs 1989 FORECAST 22

INTRODUCTION

This document presents B.C. Hydro's 1990 short term forecast of gross electric requirements.

This short term forecast consists of three sections:

(i) Base Economic and Population Forecasts

- Economic and population assumptions are described in this section.

(ii) Base Energy Forecast

- Energy sales are grouped into four sectors: residential, commercial, industrial, and others. This section describes electricity requirement assumptions and forecast methods for each sector.

(iii) Alternative Scenarios

- This section discusses the uncertainty associated with the forecast.

BASE ECONOMIC FORECAST

Information for the preparation of the economic forecast came from the B.C. Ministry of Finance and Corporate Relation.

The 1990 population forecast is the main driver of the Residential forecast.

The 1990 economic forecast provided the projected GDP growth for each commercial subsector and forms the base of the commercial forecast.

Information for the industrial forecast comes mainly from B.C. Hydro's transmission customers. Input provided by the Strategic Division of H.A. Simons Ltd. was used to prepare an outlook for the pulp and paper industry to 1995.

Sources of Inputs

Information for the preparation of the economic forecast came from the B.C. Ministry of Finance and Corporate Relations. The 1990 long term economic and population forecast provided the projected GDP growth for each subsector and the projected population growth. Input provided by the Strategic Services Division of H.A. Simons Ltd. was used to prepare an outlook for the pulp and paper industry to 1995.

Base Economic Forecast

After recovering from the last recession of the early 1980s, B.C's average growth rate of GDP is 3.7% per year from 1984 to 1989. The growth rate for 1990 is forecast to be 3.0%.

The economy is expected to enter a period of moderate growth over the next six years with a projected average annual growth rate of 2.9%. A

slower average annual growth rate of 2.5% is forecast for the next three years.

Last year, the GDP forecast was 3.0% for the same six year period and 2.9% for the next three years.

Base Population Forecast

B.C.'s population increased from 2,847,700 in 1984 to 3,053,300 in 1989, an average annual growth rate of 1.40%.

The highest growth, 2.5%, occurred in 1989, equivalent to a population increase of 76,700 for that year.

The population is forecast to rise to 3,450,700 by 1995, an average growth rate of 2.06% per year. Net inter-provincial in-migration is projected to average 26,100 per year, and net international in-immigration is expected to average 21,100 per year.

Last year, the population forecast was 1.7% for 1990 to 1995.

See Appendix D for a comparison of the 1989 and 1990 economic forecast.

Outlook

Two distinct trends emerged in the eighties.

- The growth of the service sector resulting in a more diversified economy for B.C.

- The implementation of electronic and information technology by customers of the three major sectors - residential, commercial and industrial.

These trends are expected to continue.

Although B.C.'s economy still depends heavily on primary resources, an increasing share of the economy is in the service sector. The commercial sector is expected to account for 71.9% of total GDP in 1990. This is projected to increase to 72.5% in 1996. The service subsector was 20.7% of the commercial GDP in 1990 and is projected to rise to 20.9% in 1995.

The growth of electronic and information technologies will result in higher electricity usage by customers of all three major sectors.

BASE ENERGY FORECAST

Total Energy Requirements

The base electricity forecast includes energy requirements for B.C. Hydro's integrated and non-integrated areas plus firm export and inter-utility commitments. Out-of-province interruptible sales are excluded.

Firm exports include sales nominations from West Kootenay Power (WKP), Seattle City Light (SCL), Point Roberts and Hyder in the U.S., and Alberta Power.

Total Gross Requirements

Total gross generation requirements are obtained by adding losses to the sales estimates. Losses are based on historic ratios.

Total gross generation requirements are projected to increase from 43,603 GW.h in 1989/90 to 54,720 GW.h in 1995/96 for an annual average growth rate of 3.9%. Lower than average growth is projected between 1990/91 to 1993/94 and higher than average growth is projected for the last two years of the forecast period. This represents an expansion of the present system by 25.5% over the next six years.

Energy losses are calculated in two steps. First, distribution losses are calculated as 6.9% of distribution sales. Distribution sales include all customers not served directly at transmission voltage (60 kV or above). Second, transmission losses are calculated as 8.3% of the total distribution sales, distribution losses and transmission sales. The overall result is that total losses are approximately 13% of total sales.

West Kootenay Power and Seattle City Light gross generation requirements are calculated separately.

Peak

Peak demand for the integrated system is projected to increase from 7,513 MW in 1989/90 to 9,226 MW in 1995/96 for an annual average growth rate of 3.5%. Peak demand is calculated by using load factors based on historical trends.

Peak demand for distribution customers is calculated by adding distribution sales, associated distribution losses, and associated transmission losses, and using a load factor of 59.4%. Peak demand for transmission is calculated by adding transmission sales and associated transmission losses, and using a load factor of 80.0%. The sum of the two peaks is a system load factor in the 65% to 66% range.

When calculating peak requirements, 95% diversity is allowed for WKP and 70% for SCL. The significant diversity for the SCL peak requirements reflects actual operation as SCL spreads out its limited energy purchases over an extended period of time.

Total Sales

Total sales are projected to increase from 39,284 GW.h in 1989/90 to 48,566 GW.h in 1995/96 for a six-year average annual growth rate of 3.6%.

Total annual domestic sales to residential, commercial and industrial customers are projected to increase by 8,761 GW.h by 1995/96 for an average annual growth rate of 3.4%. The residential sector accounts for 1,986 GW.h of the increase, the commercial sector accounts for 2,388 GW.h, and the industrial sector accounts for 4,387 GW.h.

Other (inter-utility and firm export) sales are forecast to increase by 566 GW.h for an average annual growth rate of 10.2% over six years.

See Appendix E for a comparison of the 1989 and 1990 sales forecast.

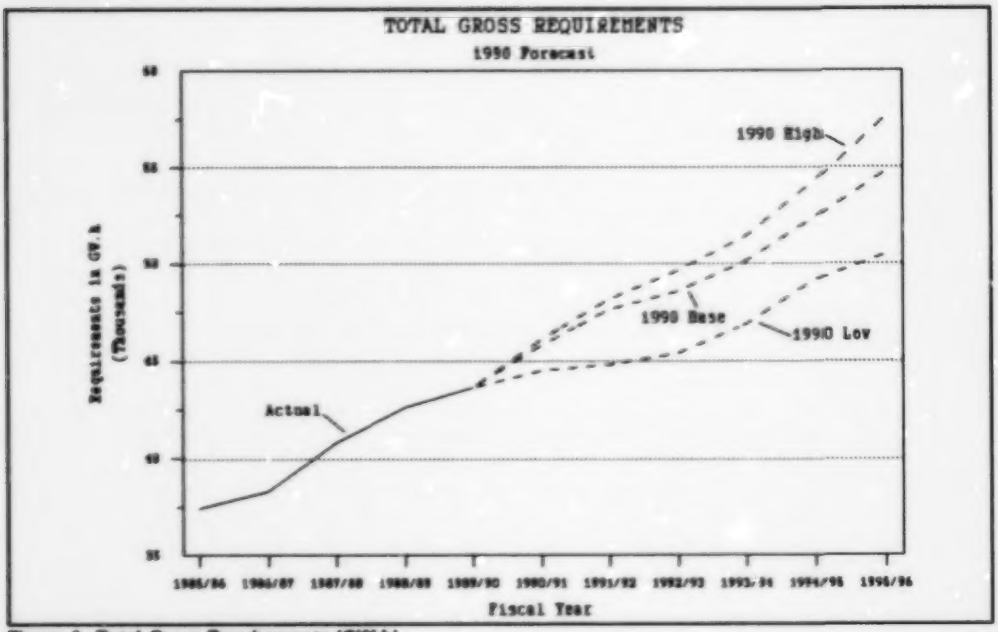

Figure 1: Total Gross Requirements (GW.h)

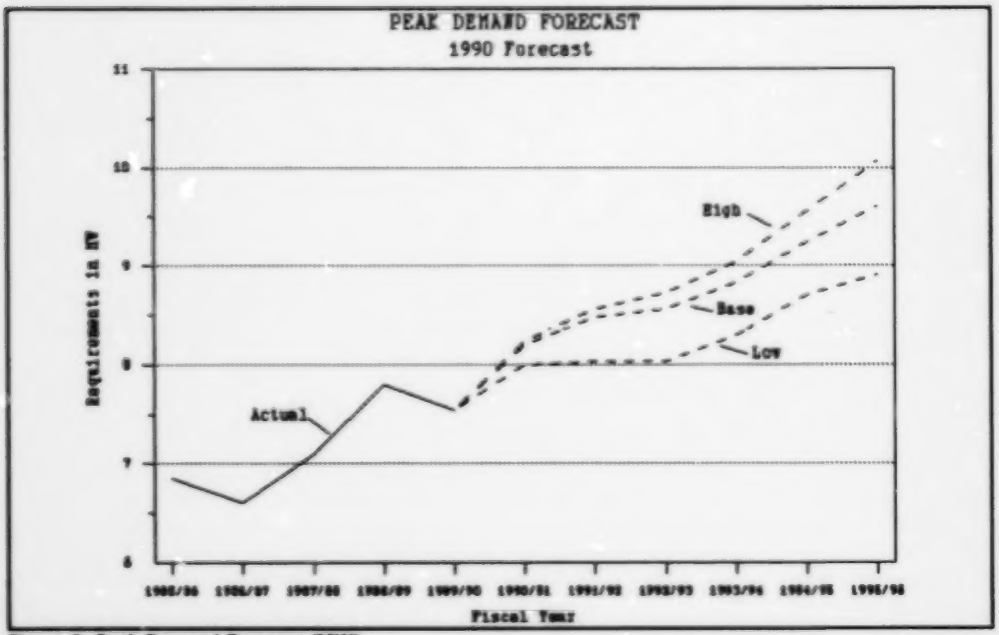

Figure 2: Peak Demand Forecast (MW)

RESIDENTIAL SALES

Residential sales are projected to increase from 11,002 GW.h in 1989/90 to 12,988 GW.h in 1995/96 for an average annual growth rate of 2.8%. The two main drivers of the residential sales are the number of accounts and the use rate (KW.h per account).

Assumptions of the residential forecast are for use rate per account to level off and for residential sales to keep pace with projected population increases.

(a) Number of Accounts

The Ministry of Finance and Corporate Relations projects population to grow at an average annual rate of 2.1% over the next six years.

The number of residential accounts is projected to grow at an average annual rate of 2.2%; approximately 25,358 additional accounts per year. The higher growth rate for number of accounts is due to the Ministry also projecting a decrease in the number of people per household from 2.55 in 1990 to 2.51 in 1995.

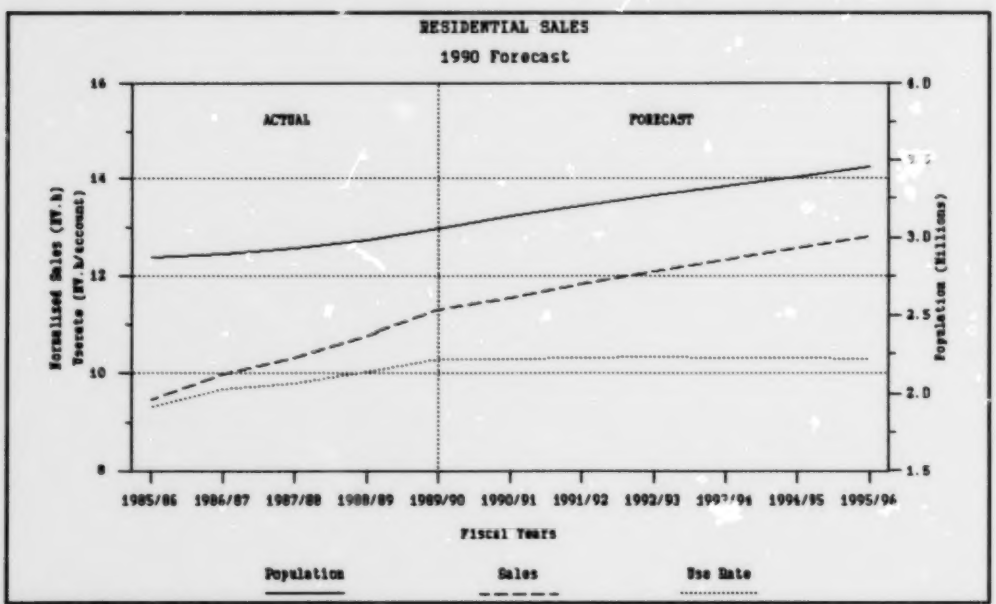

Figure 3: Residential Forecast

(b) Use Rate

When residential sales were adjusted to allow for weather effects (normalized), the 1989/90 annual use rate was 10,285 kW.h per account. Over the last five years, the normalized use rate has been increasing at an average annual rate of 2.8%. However, the use rate is expected to peak at 10,338 kW.h per account in 1992/93, and then drop to 10,292 kW.h per account in 1995/96. Use rate is expected to drop because of the combined impacts of three trends. First, the decrease in the number of people per household will result in a decrease in the number of people per account. Second, housing statistics show that the housing mix is changing due to more row houses and apartments being built. These housing types are less energy intensive than single family houses or duplexes. Third, manufacturers are making more efficient appliances, in particular refrigerators and freezers.

COMMERCIAL SALES

Commercial sales are projected to increase from 10,090 GW.h in 1989/90 to 12,433 GW.h in 1995/96 for an average annual growth rate of 3.5%.

The commercial sector consists of six subsectors:

- Transportation, Communication, and other Utilities (T.C.U.)
- Wholesale and Retail Trade (Trade)
- Finance, Insurance, and Real Estate (F.I.R.E.)
- Community, Business, and Personal Services (Service)
- Public Administration (Government)
- Unclassified

The major drivers for the commercial forecast are the GDP forecast for each subsector and the population forecast.

Assumptions for the commercial forecast are for electricity use per unit of floor stock to continue to increase and commercial sales to keep pace with commercial GDP between 1990/91 to 1994/95; then rise above the commercial GDP from 1994/95 to 1995/96.

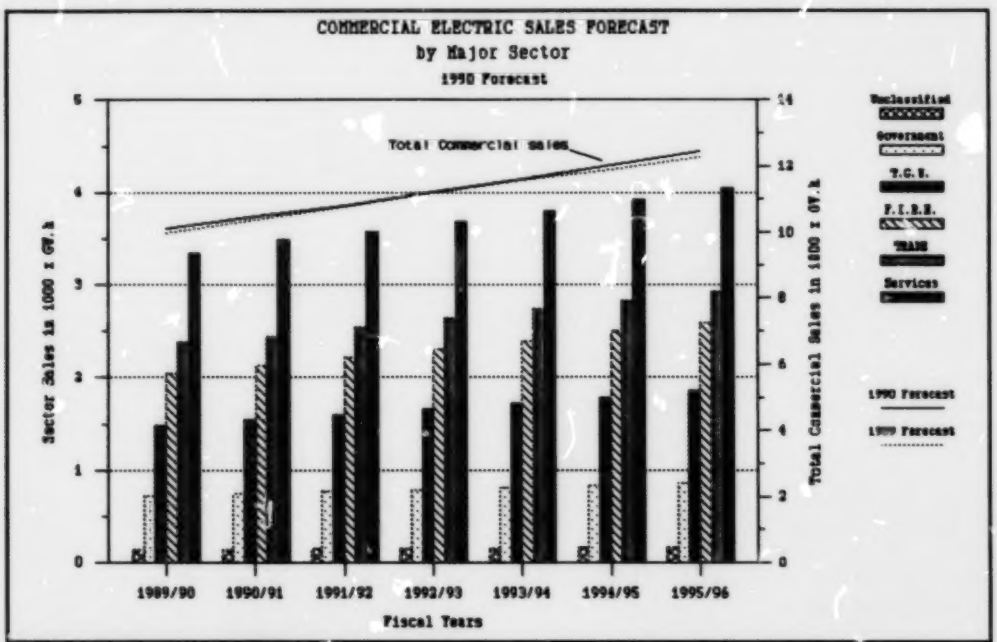

Figure 4: Commercial Sales Forecast

(a) GDP forecast

GDP is forecast to rise by 3.0% for the Service subsector; 4.0% for the Trade sector; 2.6% for F.I.R.E. sector; 3.3% for the T.C.U. subsector and 1.5% for the Government subsector.

Forecast average annual growth rates in sales are 3.4% for the Service subsector; 3.5% for the Trade subsector; 4.0% for the F.I.R.E. subsector; 4.1% for the T.C.U. subsector and 3.0% for the Government subsector.

(b) Use rate

Electricity intensity for commercial customers will increase because efficiency improvements in lighting and motors will be less than the extra load from new applications such as office automation and personal computers.

(c) Population

Higher population will generate more commercial activities and demand more services; especially in the Service, Trade and F.I.R.E. subsectors. Forecast population growth rates are taken into consideration when projecting electricity sales for these three subsectors.

INDUSTRIAL SALES

Total sales to the industrial sector are projected to increase from 17,478 GW.h in 1989/90 to 21,865 GW.h in 1995/96; an average annual growth rate of 3.8% over the next six years. Growth rates vary between years with higher than average growth projected for 1994/95 and 1995/96.

The industrial sector consists of five major subsectors:

- Paper and allied products
- Wood manufacturing
- Chemical and chemical manufacturing
- Metal mining
- Coal mining

The combined sales to customers in these five major subsectors make up 94% of the transmission sales, or 76% of total industrial sales.

Sales to miscellaneous other industrial customers are combined under the category "Remainder of Industrial sales".

The industrial forecast will continue to be dominated by the paper and allied products subsector which is projected to account for 64% of the increase of all industrial sales over the next six years.

Other forestry-related industries will see moderate growth. Seven percent of the increase in industrial sales is forecast to be from the chemical subsector, which produces largely for the pulp and paper industry, and 4% from the wood manufacturing subsector.

The mining subsector, which includes coal and metal mining, is estimated to account for 3% of total additional industrial sales.

Miscellaneous distribution and industrial load is expected to account for the balance of the 22% additional industrial sales.

Paper and Allied Products

Total sales to the paper and allied products sector were 7,972 GW.h in 1989/90. In general, the industry has some spare capacity and excess inventory for the immediate future. The operating rate of the industry is expected to be 80% between 1990/91 and 1993/94, and to increase to 90%, the average long term rate, by 1994/95.

No major new capacity is expected until 1994/95 when three new mills are projected to be added. Two of the three mills are anticipated to be serviced by B.C. Hydro, and will add 800 GW.h of load by 1995/96.

Between 1989 and 1993, additional sales will come from the CIP plant at Gold River, which added a new newsprint machine in 1989; the start up of the Louisiana Pacific thermomechanical pulp (TMP) mill at Chetwynd in 1990; and from the continuing build up of other projects including Fibreco and Howe Sound. A recycled pulp mill is expected to be in operation by 1993 adding 47 GW.h of annual load. Total load increase between 1989 and 1993 is projected to be 1,202 GW.h.

Total sales are projected to be 10,772 GW.h by 1995/96. The large increase in electricity purchases is not so much due to increased production as to the pulping technologies being used. Mechanical pulp in the form of chemi-thermal mechanical pulp (CTMP) is now being extensively used in new paper production in B.C. as well as being sold as a market pulp. CTMP is much more electricity-intensive than conventional chemical pulp, and its production process is not suitable for cogeneration. The long term expansion of this industry will be curtailed by wood fibre availability.

Total additional load is expected to be 2,800 GW.h over the next six years.

Wood Manufacturing

Growth in sales to the wood manufacturing sector is assumed to remain moderate over the entire forecast period. In the short term, U.S. housing starts are expected to be lower, and this has the effect of dampening lumber prices as well as requirements. Because the maximum annual allowable cut has essentially been reached, sales growth will occur largely from technological upgrading and the addition of more value-added products. The forecast includes a new fibreboard plant expected to go into operation in 1992. The plant is projected to require 40 GW.h in 1992/93, and to grow to require 100 GW.h by 1995/96.

Total additional load is expected to be 190 GW.h over the next six years.

Chemical and Chemical Manufacturing

The six customers that produce chemicals for the pulp and paper industry account for nearly 90% of sales to this subsector. No major additional load is projected over the entire forecast period after existing expansions and additions are completed. Growth in load will be from expansions made by manufacturers to produce sodium chlorate from which chorine dioxide is produced. Chlorine usage in pulp bleaching is being replaced by chlorine dioxide because of environmental problems with chlorine.

Total additional load is projected to be 290 GW.h over the next six years.

Metal Mining

This subsector currently consists of eleven major customers. Most of the growth in this subsector will be from the largest customer, Highland Valley Copper. Between 1990 and 1992, two new mines are coming into production - Westmin and Goldstream - and two mines are expected to shut down - Brenda and Equity. Bell Copper was projected to close in 1993. However, recent information indicates that because new mineral deposits were recently located, and the mine is proposing an expansion, it is expected to continue operations beyond 1995. One new mine, Mount Milligan, is expected to start operating in 1994. The limiting factors to further mining development are the long term outlook of copper prices and the depletion of economic ore reserves.

Total additional load is projected to be 90 GW.h over the next six year.

Coal Mining

This subsector currently consists of seven customers. The three large customers - Quintette, Westar and Fording - are expected to continue their current level of production. Constant levels of production are also forecast for three of the smaller customers - Bullmoose, Westar-Greenhills and Crows Nest.

Two new customers are expected. Quinsam is forecast to start in 1992, and Telkwa in 1993. The two new mines will add 35 GW.h of load by 1995.

Total sales to this subsector are expected to grow from 659 GW.h in 1989 to 745 GW.h in 1995.

Remainder of Industrial

The remaining industries are, in general, smaller consumers of purchased electricity. The only major additional load in the forecast is the assumption of a Ferrochromium smelter coming on line in 1993, adding 230 GW.h of load by 1995.

Sales to the non-metallic mineral products manufacturing subsector are primarily to three large cement plants. One manufacturer is planning an expansion for exporting to the U.S., resulting in an expected increase of 40 GW.h in sales by 1995. Otherwise, sales are forecast to remain flat over the entire forecast period.

The Petroleum and Coal Products Manufacturing subsector contains seven major refineries which account for 95% of the load. Little growth in refinery load is anticipated.

Miscellaneous Manufacturing is largely non-resource based and contains no electricity intensive customers. Growth rate is expected to be in line with the respective sectoral GDP.

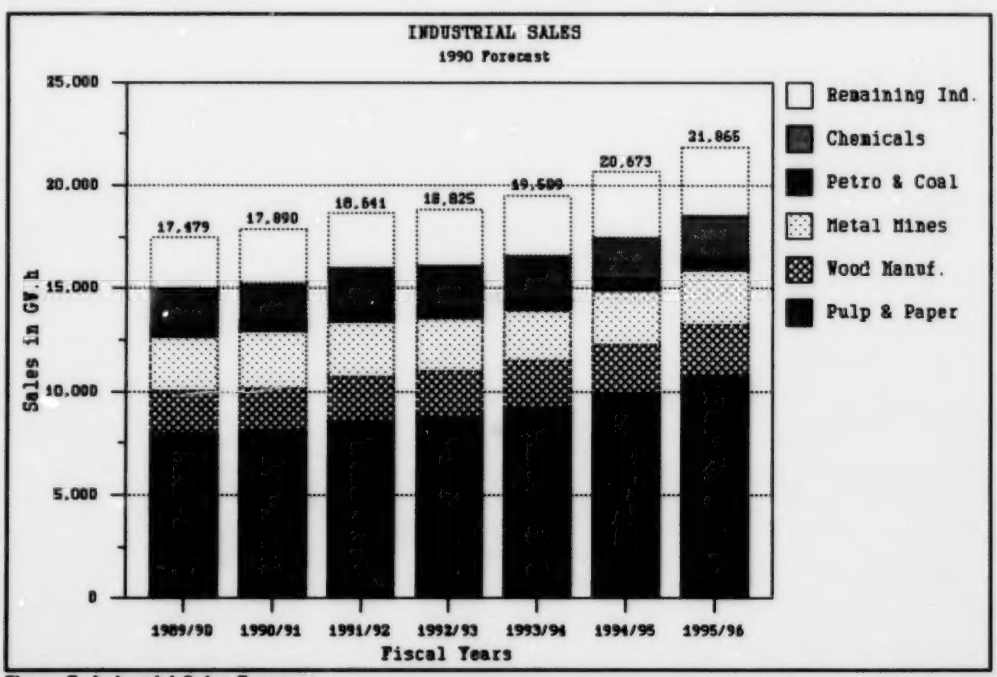

Figure 5: Industrial Sales Forecast

OTHER SALES

Inter-utility and firm out-of-province sales make up the other sales category. Total sales are forecast to increase from 714 GW.h in 1989/90 to 1,280 GW.h in 1995/96 for an average annual growth of 10.2%.

Two customers are included in inter-utility. The first is the City of New Westminster which purchases bulk energy from B.C.Hydro for its own distribution system. The other is West Kootenay Power (WKP) whose requirements are projected to grow from 62 GW.h in 1989/90 to 578 GW.h in 1995/96. Their purchases are regulated by the B.C. Utilities Commission which requires that WKP nominate annually their capacity and energy requirements to B.C.Hydro.

There are four firm out-of-province contracts. Seattle City Light (SCL) sales under the Skagit agreement account for the majority of sales. They are set at 318 GW.h annually. The other contracts are to Point Roberts in Washington, Hyder in Alaska, and to Alberta Power in the Peace River area.

POWER SMART PROGRAMS

Power Smart is B.C. Hydro's name for demand side management programs. These programs are B.C.Hydro's initiatives designed to encourage customers to use electricity as efficiently as possible, subsequently reducing the utility's load. Estimated reductions from the Power Smart Programs would be over and above the ongoing (price-induced) conservation assumed to occur in the base forecast contained in this document and are being treated as energy sources for resource planning.

SENSITIVITY ANALYSIS

Alternative scenarios of potential changes which could impact electricity sales are analyzed. Two possible alternatives are considered to reflect the upper and lower bounds of uncertainty. The alternative analysis concentrates on three factors: the effects of changes in population growth on residential sales; variations in the commercial Gross Domestic Product (GDP); and variations in the expansion plans and operating levels of the province's pulp and paper mills. Two possible situations (high and low) were examined for each of these factors. The results were combined to yield two overall sensitivity forecasts, a high demand scenario and a low demand scenario. Tables in Appendix A summarize the relevant forecast assumptions and their impacts on electricity sales.

The lower demand scenario is designed to address concerns about a possible downturn in the economy by emulating the economic conditions of B.C.'s last major recession in the early 1980s.

The high demand scenario assumes B.C. will escape the worst of the economic downturn in the near term and will have a higher than expected growth towards the end of the forecast period.

A. Residential Sales

The key factor affecting residential sales is population growth.

The average annual B.C. population growth rate between 1982 to 1988, which includes the

diminished population growth during the economic slowdowns of 1981/82 and 1986, is 1.2%. The same growth rate is used to represent a low population growth scenario and would reduce cumulative residential sales by 2,330 GW.h over the next six years.

The high population growth scenario assumes that the rate of increase for 1989 of 2.5% will continue over the forecast period and would increase residential sales by a cumulative 798 GW.h over the next six years.

B. Commercial Sales

The B.C. commercial GDP is used as the indicator of commercial electricity sales.

During the last recession period of the early 1980s, B.C.'s GDP dropped 3.7% between 1981 and 1982, then grew by 0.9% in 1983. A similar pattern is assumed for the lower demand scenario and would drop GDP growth for 1990/91 and 1991/92. Lower GDP growth rates are assumed for the rest of the forecast period to reflect a slow recovery similar to the period between 1984 to 1989. A cumulative reduction in commercial sales of 4,290 GW.h would result under the low GDP growth scenario.

The high demand case assumes that commercial GDP would be the same as the base case projections for 1990/91 and 1991/92, then increase by 50% higher than the base case forecast from 1992/93 to 1995/96. This reflects a much stronger economy than expected. A total cumulative increase in commercial sales of 1,776 GW.h would result over the forecast period.

C. Industrial Sales

The paper and allied products subsector consumes 46% of total industrial electricity sales in 1989/90 and accounts for 20% of B.C. Hydro's total electricity sales.

Sensitivity analysis is performed on three factors affecting sales to the paper and allied products subsector: the industry-wide operating rate; the build-up rate of ongoing or planned mill expansion and the addition of new mills within the forecast period.

In the lower demand scenario, the industry operating rate would drop to 70% in 1991/92, return to 75% in 1992/93, increase to 80% in 1993/94, and rise to 85% for both 1994/95 and 1995/96. Mill expansions are assumed to be brought onstream at a slower rate or deferred by a year. Only one new TMP mill is assumed to be required within the forecast period. The resulting cumulative decrease in industrial sales would be 9,628 GW.h.

The high scenario assumes an operating rate of 85% for 1990/91, then gradually rises to 100% by 1995/96. The build-up rate of mill expansions is accelerated. Both new (TMP) mills will be built and brought onstream a year earlier than anticipated. The high demand scenario would result in a total cumulative increase of 4,551 GW.h over the forecast period.

D. Combined Scenarios

1. Low Demand Scenario

The low demand scenario combines the lower-than-expected case results for each of the above three factors. The greatest reduction in demand likely to be faced by B.C. Hydro over the forecast period is the sum of: 2,330 GW.h less residential sales due to reduced population growth; 4,289 GW.h less commercial sales caused by recession and slower economic growth; and 9,628 GW.h less demanded by the paper and allied industries because of lower operating levels and reduced expansion rates. Combined, these numbers yield a total cumulative reduction of 16,247 GW.h over the forecast period.

In comparison to the base case overall utility sales growth rate of 3.6%, the low demand scenario results in a growth rate of 2.2%.

2. High Demand Scenario

The highest likely increase in forecast demand is the sum of: an increase of 798 GW.h due to higher-than-expected population growth; 1,776 GW.h more commercial sales because of a booming economy; and 4,551 GW.h more for pulp and paper mills operating at or near capacity, and for new TMP mills and other expansions. The total cumulative increase is 7,125 GW.h.

This increase in utility sales represents a six year average growth rate of 4.5%.

APPENDIX A

SENSITIVITY ANALYSIS METHODOLOGY

Many factors affect total electricity demand. This sensitivity analysis selects the three factors with the greatest potential impacts on electricity sales: the effects of changes in population growth on residential sales; variations in the commercial Gross Domestic Product (GDP); and variations in the expansion plans and operating levels of the province's pulp and paper mills. Two situations are examined for each of these factors: a situation of a higher-than-expected demand, and a lower-than-expected demand. The results are combined to yield two overall sensitivity forecasts: a high demand scenario and a low demand scenario.

A. RESIDENTIAL SALES

Sensitivity analysis is based on changes in projected population growth.

The latest estimates indicate that B.C.'s population is expected to increase by 2.1% over the forecast period (1990/91-1995/96). The effects of population changes on residential sales are broken out by taking the projected population increase for each year and expressing it as a fraction of the total percentage increase in sales for that same year. The forecast increase in GW.h is multiplied by this fraction to determine the amount of electricity sales attributable to population changes alone. It is then possible to increase or decrease total sales to reflect population changes, while keeping the contribution of other factors (such as use rates) constant.

The average B.C. population growth rate for the period 1982-1988, which includes the diminished population increases during the economic slowdowns of 1982 and 1986, was 1.2% per year. The same growth rate is therefore appropriate to use for the short term forecast to estimate the effects of another major recession.

The high population growth scenario assumes that the rate of increase observed in 1989, 2.5%, continued over the forecast period. This rate of increase is the highest observed in the last eight years.

B. COMMERCIAL SALES

The B.C. commercial GDP is used as the indicator of the electricity demands of commercial customers. The commercial sector accounts for 71% of the total provincial GDP.

The low demand case assumes that a recession comparable to that of 1981/82 is experienced by B.C. in the very near future. As the provincial economy slows, GDP growth in 1990/91 decreases slightly from the projected increase of 3.95% to 3.23% (the 1984-89 average). Historical data indicate that during the last major recession, the B.C. GDP decreased by 3.7% between 1981 and 1982. The commercial sector is assumed to experience a similar severe drop between 1990/91 and 1991/92. In 1983, the B.C. GDP grew slightly (0.9%); this same growth rate is assumed between 1992/93 and 1993/94. Forecast GDP growth rates for fiscal years 1993/94, 1994/95 and 1995/96 are assumed to be 85, 90 and 90%, respectively, of the base case forecasts for GDP increases. These slightly lower growth rates reflect the economy returning to a healthy, but not quite as active state as before the recession.

In the high demand case, GDP is assumed to be the same as the base case for 1990/91 and 1991/92. Increases of 50% higher than the base forecast from 1992/93 to 1995/96 to represent a stronger than expected economy.

C. INDUSTRIAL SALES

The province's paper and allied products industry is B.C. Hydro's largest industrial customer, accounting for 46% of total industrial sales in 1989/90. In terms of total sales, the paper and allied products industry represents 20% of all GW.h sold.

Three factors are examined in the sensitivity analysis of forecast electricity sales to the paper and allied products industry. The first is the industry operating level; the assumed operating level is raised and lowered by specified amounts for the high and low scenario, respectively. The second factor is the build-up rate of ongoing or planned mill expansions. A number of mills are adding capacity or otherwise changing their electricity demands. As well, one thermomechanical pulp (TMP) mill is currently building up to full capacity, while a second TMP mill which has just been constructed is in the process of starting up. The third factor is the likelihood of two additional TMP mills being added to the utility grid by the end of the forecast period. Thus, there are a number of possible scenarios whereby industrial sales could be significantly impacted.

In the low scenario, it is assumed that one of the two new TMP mills currently planned for the interior will not be constructed during the forecast period. Other mill expansions are taken to be brought onstream at a slower rate or deferred a year relative to the base forecast. Forecast drops in mill demand not related to production output changes (such as from increased operating efficiency) are still taken to occur since they would reduce industry-wide demand. The industry operating level would drop from the estimated 1989/90 level of 84% to 75% in 1990/91 (in keeping with the Canada-wide average operating level), then to 70% in 1991/92 to reflect a relatively serious national economic downturn. After 1991/92, the operating level is assumed to slowly rise to 75% in 1992/93, to 80% in 1993/94, and to 85% for both 1994/95 and 1995/96.

The high scenario assumes that both new interior TMP mills will be built, and will be brought onstream a year earlier than anticipated. Minor forecast drops in mill demand are delayed or taken to occur in slower increments. The build-up rate of the two newest TMP mills is accelerated, as are the major additions to industry capacity. Operating levels are taken to increase throughout the forecast period. For 1990/91, an 85% operating level, only slightly higher than the 1989/90 operating level, is assumed. A steady increase in operating level is also assumed until the industry is operating at 100% of rated capacity in 1995/96.

D. COMBINED SCENARIOS

1. Low Demand Scenario

The low demand scenario combines the results for each of the above factors to arrive at an estimate of the lowest likely demand to be faced by B.C. Hydro over the forecast period. The combined cumulative reduction in load is the sum of: 2,330 GW.h less residential sales due to reduced population growth; 4,290 GW.h less commercial sales caused by recession and slower economic growth; and 9,628 GW.h less industrial sales because of lower operating levels and reduced expansion rates by the paper and allied products industry.

2. High Demand Scenario

The potential increase in forecast demand from the three factors examined is the sum of: an increase of 798 GW.h due to higher-than-expected population growth; 1,776 GW.h more commercial sales because of a healthier than expected economy; and 4,551 GW.h more for pulp and paper mills operating at or near capacity, and for new TMP mills and other expansions.

Sensitivity Analysis Summary

Low Case

	Forecast Demand (GW.h)							
	1989/90 (actuals)	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	Avg. 6-yr Growth
Residential	11002	11242	11417	11652	11881	12138	12393	2.00
Commercial	10090	10431	10224	10368	10716	11083	11466	2.15
Industrial	17478	16925	16957	17179	17943	19251	19519	1.86
Other	714	774	1019	935	937	1075	1280	10.22
Total	39284	39372	39617	40134	41477	43547	44658	2.16
Base Forecast Total	39284	40537	42165	42983	44381	46420	48566	3.60
Total Change (GW.h)	N/A	-1165	-2548	-2849	-2904	-2873	-3908	
% Decrease	N/A	2.87	6.04	6.63	6.54	6.19	8.05	
Residential Reduction red'd popln growth	N/A	-142	-268	-361	-445	-519	-595	
Commercial Reduction lower GDP	N/A	-58	-596	-842	-893	-933	-967	
Industrial Reduction P&P ind. slowdown	N/A	-965	-1684	-1646	-1566	-1421	-2346	
P&P ind. op. level	84%	75%	70%	75%	80%	85%	85%	
% Change in GDP	same	3.23	-2.60	0.90	2.63	3.10	2.56	
Base forecast GDP	same	3.95	3.16	3.60	3.56	3.51	3.47	
% Population change	same	1.2	1.2	1.2	1.2	1.2	1.2	
Base forecast	same	2.5	2.3	2.0	1.9	1.8	1.8	

Sensitivity Analysis Summary

High Case

	Forecast Demand (GW.h)							
	1989/90 (actuals)	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	Avg. 6-yr Growth
Residential	11002	11384	11708	12094	12479	12896	13290	3.20
Commercial	10090	10489	10820	11382	11954	12560	13148	4.51
Industrial	17478	18163	19112	19560	20166	21595	23357	4.95
Other	714	774	1019	935	937	1075	1280	10.22
Total	39284	40537	42659	43971	45536	48126	51075	4.47
Forecast Total	39284	40537	42165	42983	44381	46420	48566	3.60
Change (GW.h)	N/A	273	494	988	1155	1706	2509	
% Increase	N/A	0.67	1.17	2.30	2.60	3.68	5.17	
Residential Increase incr'd popln growth	N/A	0	23	81	153	239	302	
Commercial Increase higher GDP	N/A	0	0	172	345	544	715	
Industrial Increase P&P ind. upturn	N/A	273	471	735	657	923	1492	
P&P ind. op. level	84%	85%	87%	90%	92%	95%	100%	
% Change in GDP	same	3.95	3.16	4.76	4.64	5.16	4.26	
Base forecast GDP	same	3.95	3.16	3.60	3.56	3.51	3.47	
% Population change	same	2.5	2.5	2.5	2.5	2.5	2.5	
Base forecast	same	2.5	2.3	2.0	1.9	1.8	1.8	

APPENDIX B

INPUTS TO THE FORECAST

The following details the major inputs and sources of information that drive the forecasts:

a) **Residential**

- Migration and total population forecasts are obtained from the Planning and Statistics Division of the B.C. Ministry of Finance and Corporate Relations (MF&CR).
- Historic fertility, mortality, migration, migrant age profile, and census data are obtained from Statistics Canada.
- Historic headship rates and dwelling preference are obtained from Statistics Canada.
- B.C. Hydro accounts by dwelling type and by region are obtained from the Operation Supports Department in Western Integrated Technology Ltd.
- Demolition and conversion data come from the Field Service Order System maintained by the Market Planning and Evaluation Department.
- Two-year account projections are estimated by district office staff and cumulated by Forecasting.
- Historical account and total energy use information is obtained from the Load Forecast Information System (LFIS) - adjusted billing statistics.
- Degree day statistics are obtained from the Marketing Division.
- Base year load profiles are developed using the Residential End-Use Survey - 1988 for appliance saturations and Energy Management data sheets specifying estimated consumption rates for appliances.
- Projections of trends in energy consumption for appliances come from B.C. Hydro's Residential Energy Management Department (part of Marketing).
- Comparative information on appliance saturations and use trends are obtained from other utilities through the Canadian Electrical Association (CEA) and the Electric Power Research Institute (EPRI) in the U.S.
- Space heating capture rates are available from Field Service Order System.
- Furnace efficiencies are determined from information obtained from the Residential Energy Management Department.
- Energy price projections are developed with assistance from consultants.

b) **Commercial**

- Sectoral GDP projections come from the Ministry of Finance and Corporate Relations (MF&CR).

- B.C. Population Forecast from the Ministry of Finance and Corporate Relations (MF&CR).
- Historical sales data are from LFIS and from the ICA System.
- Load profiles are developed from Commercial Energy Management data and from other utility data.
- Use patterns for various building types are obtained from a customer data base maintained by Commercial Energy Management.
- Forecast use trends are developed from specific application trends given by Commercial Energy Management.

c) Industrial

- Key industry (electricity-intensive) world and provincial outlooks are obtained from consultants.
- Historic consumption data come from LFIS/ICA and the Customer Information Control System (CICS).
- Short-term projections (one to five years) are based on consultation with all major customers through the Transmission Customer Services Department.
- Energy use trends are obtained from recent studies, consultant inputs and historical trends.
- Reviews of the key sectors of the projections are solicited from provincial government agencies, consultants and other organizations.

APPENDIX C

B.C. HYDRO BASE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS
(Including SCL & WKP)

	Residen-tial (GW.h)	Commer-cial (GW.h)	Indus-trial (GW.h)	Other (GW.h)	WKP (GW.h)	SCL (GW.h)	Total Sales (GW.h)	Losses/ Accruals (GW.h)	TOTAL GROSS REQ'TS (GW.h)	Less Non-Integr. (GW.h)	INTEGR. SYSTEM TOTAL GROSS REQ'TS (GW.h)	PEAK (MW)
Actual												
1985/86	9793	8315	14571	281	41	134	33135	4289	37424	166	37258	6816
1986/87	9665	8678	15365	286	16	320	34330	3971	38301	167	38135	6567
1987/88	9902	9060	16426	291	77	312	36068	4725	40793	165	40628	7060
1988/89	10700	9569	16713	312	109	312	37715	4897	42612	176	42436	7765
1989/90	11002	10090	17478	321	62	331	39284	4319	43603	172	43431	7513
Forecast												
1990/91	11384	10489	17890	332	124	318	40537	5252	45789	175	45614	8157
1991/92	11685	10820	18641	341	360	318	42165	5438	47603	182	47421	8441
1992/93	12013	11210	18825	352	265	318	42983	5569	48552	186	48366	8513
1993/94	12326	11609	19509	362	257	318	44381	5746	50127	190	49937	8788
1994/95	12657	12016	20672	373	384	318	46420	5977	52397	194	52203	9196
1995/96	12988	12433	21865	384	578	318	48566	6217	54783	199	54584	9568
Avg. Ann.% incr. 6 years:												
89/90-95/96	2.8%	3.5%	3.8%	3.0%	45.1%	-0.7%	3.6%	6.3%	3.9%	2.6%	3.9%	4.1%

APPENDIX D

COMPARISON OF B.C. GDP
@ Factor Cost ($1981 Millions)

Year	1990 Forecast	1989 Forecast	Percent Change (%) 1990 Forecast	1989 Forecast
1984	39,553			
1985	42,190		6.7%	
1986	41,519		-1.6%	
1987	43,448		4.7%	
1988	45,186		4.0%	
1989	47,400	46,872	4.9%	3.7%
1990	48,822	48,108	3.0%	2.6%
1991	49,554	49,611	1.5%	3.1%
1992	51,041	51,137	3.0%	3.1%
1993	52,521	52,695	2.9%	3.1%
1994	54,097	54,425	3.0%	3.3%
1995	56,193	55,775	3.9%	2.5%
Growth Rates:				
Last 5 yrs	3.7%	3.5%		
Last year	4.9%	3.7%		
Current year	3.0%	2.6%		
Next 3 yrs	2.5%	3.0%		
Next 6 yrs	2.9%	2.9%		

COMPARISON OF B.C. POPULATION
Thousands

Year	1990 Forecast	1989 Forecast	Percent Change (%) 1990 Forecast	1989 Forecast
1984	2,848			
1985	2,870		0.8%	
1986	2,889		0.7%	
1987	2,925		1.3%	
1988	2,980		1.9%	
1989	3,053	3,047	2.5%	2.3%
1990	3,130	3,105	2.5%	1.9%
1991	3,203	3,160	2.3%	1.8%
1992	3,267	3,215	2.0%	1.7%
1993	3,328	3,268	1.9%	1.7%
1994	3,389	3,317	1.8%	1.5%
1995	3,451	3,366	1.8%	1.5%
Growth Rates:				
Last 5 yrs	1.4%	1.4%		
Last year	2.5%	2.3%		
Current year	2.5%	1.9%		
Next 3 yrs	2.3%	1.8%		
Next 6 yrs	2.1%	1.7%		

APPENDIX E

B.C. HYDRO
COMPARISON OF 1990 vs 1989 FORECAST
BY STANDARD INDUSTRIAL CLASSIFICATION (SIC)
(Billed Basis, No Adjustment for Accruals)
SALES in GW.h

	JULY 1990 FORECAST							Growth	JULY 1989 FORECAST							Growth
	1989/90 (Actual)	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	(%) Avg 6 yrs	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	(%) Avg 6 yrs
RESIDENTIAL	11,002	11,384	11,685	12,013	12,326	12,657	12,988	2.80%	10,959	11,257	11,55[illegible]	11,839	12,113	12,373	12,630	2.39%
COMMERCIAL - Total	10,090	10,489	10,820	11,210	11,609	12,016	12,433	3.54%	9,966	10,384	10,784	11,190	11,563	11,894	12,283	3.55%
Distribution	9,673	10,065	10,391	10,781	11,170	11,577	11,989	3.64%	9,556	9,954	10,349	10,750	11,118	11,444	11,833	3.63%
- T.C.U.	1,315	1,365	1,425	1,485	1,542	1,608	1,675	4.12%	1,269	1,315	1,374	1,425	1,466	1,511	1,562	3.52%
- Trade	2,377	2,443	2,536	2,636	2,735	2,829	2,927	3.53%	2,396	2,511	2,614	2,723	2,833	2,934	3,026	3.97%
- F.I.R.E.	2,043	2,133	2,211	2,299	2,391	2,486	2,586	4.01%	1,933	2,006	2,080	2,157	2,237	2,241	2,312	3.03%
- C.B.P.S.	3,121	3,278	3,351	3,464	3,578	3,703	3,825	3.45%	3,131	3,260	3,395	3,531	3,640	3,793	3,943	3.92%
- Public Admin.	682	707	726	749	772	794	816	3.03%	704	735	756	781	805	827	848	3.15%
- Unclassified	135	139	142	148	152	157	160	2.87%	123	127	130	133	137	138	142	2.42%
Transmission	417	424	429	429	439	439	444	1.05%	410	430	435	440	445	450	450	1.56%
INDUSTRIAL - Total	17,478	17,890	18,641	18,825	19,509	20,672	21,865	3.80%	17,519	18,173	19,018	19,613	20,286	20,865	21,583	3.54%
Distribution	3,479	3,558	3,636	3,733	3,838	3,941	4,044	2.54%	3,454	3,553	3,648	3,748	3,851	3,955	4,063	2.74%
Transmission	13,999	14,332	15,005	15,092	15,671	16,731	17,821	4.11%	14,065	14,620	15,370	15,865	16,435	16,910	17,520	3.73%
- Metal Mines	2,496	2,625	2,577	2,417	2,372	2,477	2,582	0.57%	2,610	2,780	2,660	2,490	2,445	2,550	2,655	0.29%
- Coal Mines	652	662	675	675	680	690	720	1.49%	645	675	685	705	735	745	750	2.55%
- Wood Manuf.	482	482	540	587	622	649	674	5.75%	490	490	505	520	535	550	565	2.40%
- Paper & Allied	7,972	8,112	8,546	8,755	9,174	9,937	10,772	5.14%	7,930	8,210	8,810	9,270	9,680	9,970	10,390	4.61%
- Chemical	1,669	1,719	1,922	1,908	1,958	1,958	1,958	2.70%	1,675	1,755	1,885	1,950	1,995	1,995	1,995	2.96%
- Remaining Trans.	721	732	745	750	865	1,020	1,115	7.54%	715	710	825	930	1,045	1,100	1,165	8.48%
TOTAL TR.& DIST.SALES	38,570	39,763	41,146	42,048	43,444	45,345	47,286	3.45%	38,444	39,814	41,357	42,642	43,962	45,132	46,496	3.22%
OTHERS																
- WKP&L	62	124	360	265	257	384	578	45.07%	230	332	400	273	288	302	306	4.87%
- SCL	331	318	318	318	318	318	318	-0.67%	318	318	318	318	318	318	318	0.00%
- Inter Utility	302	312	321	331	341	351	362	3.07%	303	312	321	331	341	351	362	3.01%
- Out of Prov. firm	19	20	20	21	21	22	22	2.47%	18	19	20	20	21	21	22	3.40%
TOTAL SALES	39,284	40,537	42,165	42,983	44,381	46,420	48,566	3.60%	39,313	40,795	42,416	43,584	44,930	46,124	47,504	3.20%